

General Observations on Vegetational Change in the Cooper System

The most impressive changes that have occurred in the Cooper system did not occur in the 4 fields we selected for quantitative sampling. Our ground level survey and low level flights showed large areas of previously open water fields, especially on the east branch, being covered by *Ludwigia uruguayensis* and *Eichornia*. Mild winters in the past decade have helped the expansion of these two species, which are controlled by hard freezes. *Ludwigia* has also taken advantage of lowered water levels to colonize slightly more elevated areas scattered throughout what were prerediversion *Egeria* flats. Waterways into and within fields that were open to fishing in 1982 are now closed. *Ludwigia* islands of 1982 can now be seen to incorporate *Pontederia* and *Zizaniopsis* plants. *Zizaniopsis* stands which were extensive throughout the system are giving way to mixtures of intertidal emergents. In the upper reaches of the east branch, Back River, Molly Branch and in diked fields at and above Mepkin, tree cover is becoming pronounced. Large areas of open water still predominate on many west branch fields; e.g., Strawberry, Mulberry, Bonneau Ferry and Pimlico.

Plant Species List and a Proposed Successional Pattern

Table 1 is a checklist of all vascular plants collected by Porcher from creek banks and freshwater intertidal areas along the upper Cooper system during the 1982 - 1994 period. Figure 38 presents a suggested successional pattern for the Cooper system based on our observations and measurements.

Discussion

It is clear that vegetational change in the freshwater water marshes of the upper Cooper River has accelerated since the rediversion. Stalter and Baden (1994) returned to three remnant rice fields near Georgetown, to assess change since 1968 (Baden et al., 1975). In that situation where no sudden change in succession driving factors has occurred, change is slow. They found few changes in species composition/distribution since their original study. In the Cooper system the sudden lowering of water levels led to measurable change in a variety of vegetational attributes over a 6 year period (Kelley,

Porcher and Michel, 1990). The present study documents continuing change.

In preparing their fields for cultivation in tidal, rice growers attempted to level flat areas to get even depths of water coverage when they were flooded for weed control and the stretch flow (Doar, 1970). In many cases original elevations subsided after years of cultivation and erosion, making the fields difficult to drain. Fields near the downstream end of the freshwater tidal zone tend to be large, have low interior elevation and experience the greatest tidal range. When daily tidal flow returned as dikes failed, these fields became lake-like at high tide with interditch areas covered with submergents (*Egeria* and *Cabomba*) and emergents (*Pontederia* and *Zizaniopsis*) forming a fringe in shallow edge waters. Farther upstream where base elevations are higher and tidal range is smaller, the lake-like stage is either skipped or passed through quickly producing a field covered seasonally by broad leaf perennials (*Pontederia*, *Cicuta* and *Peltandra*) followed by grasses and sedges (*Zizaniopsis* and *Scirpus* sp.) and finally by mid-summer with a middle story of vines and other plants (*Apios*, *Mikania*, *Lycopus*, *Alternanthera*, *Aneilima*). These upstream fields are eventually invaded by trees tolerant of saturated soils (*Acer*, *Salix*, *Baccharis*, *Myrica* and *Nyssa*). To date all fields on the upper Cooper still have saturated soils on all tides.

Returning to downstream fields, the large open water fields accumulate sediments over time raising the elevations of the interditch flats and allowing rooted emergents to become established or, as in the case of the redirection, water levels are lowered creating water cover patterns comparable to those that would result from bottom elevation due to sediment accumulation. Sediment depth and composition may be a factor in vegetational succession that is not replicated by lowering water levels but prerediversion sediments were thick (3 feet + and thicker than the depth of root penetration of the emergent plants growing on them) and at least had the appearance of uniform composition.

Over the period of the study in the Cooper system, one plant species, *Ludwigia uruguayensis*, seemed to have had the role of being the first rooted emergent to close open water areas. Interestingly, *L. uruguayensis* is not a factor on the South Edisto River where remnant rice field succession is also in progress. *Ludwigia* has a woody stem but depends on water buoyancy to provide much of its support. It can root in shallow areas and extend out over deeper water for a considerable distance. Since 1988, *Eichornia* (water hyacinth, a floating plant with short roots in water) has appeared and is spreading in both tidal and impounded fields. In 1994-95 we typically found it entangled with *Ludwigia* making a

light blocking cover on the water surface and closing many areas of formerly open water to boaters. *Pontederia* and *Zizaniopsis* islands appear within the *Ludwigia* mats and expand outward as water depth permits. Fringing marsh also extends into *Ludwigia* mats. Further accumulation of sediments in dense rootmats or lowered water levels allow new species to invade *Pontederia/Zizaniopsis* stands leading to increased species complexity, less concentration of biomass among dominant species and a pattern of primary productivity marked by a series of seasonal peaks as different species reach their individual peaks. Eventually, *Zizaniopsis* thins from mixed stands at higher elevation leaving what we have termed the ITEM (intertidal emergent mix) which persists through tree invasion. One side pattern that is observed in deep ditches (Medway) or in impoundments that permanently hold water (fig. 2, fields along the east side of the west branch above Mepkin Abbey) is the formation of a floating rootmat that traps enough sediment to allow the development of floating emergent communities that may even support trees and be free to move horizontally in the wind. In shallow flat fields the developing community is in firm contact with the substratum. Figure 38 summarizes these events.

Observations of the open water/*Ludwigia* mat fields suggest that they are especially attractive to wading birds, diving birds (especially ospreys and eagles), fishermen and hunters. We have also observed waterfowl using open areas behind blocked breaches and ditches as refuges. Dip net samples taken beneath these mats show concentrations of amphipods, cladocerans, ostracods, insect larvae, flatworms, snails and other invertebrates. In the late 1970s large flocks of ducks and coots occupied these areas from October to February. In the past decade, water fowl presence on the upper Cooper has steadily declined due in part to factors outside the region but also due to local factors including development of surrounding areas and increased boat traffic/disturbance throughout the year. Open water fields can also be seen to export large amounts of dead or broken pieces of *Egeria* on outgoing tides in every month of the year.

Mid successional stage fields with interditch areas covered by emergents are different from open water fields in their ecological functions, animal residents and recreational uses. At Dean Hall for example fiddler crabs/ burrows (*Uca minax*) are common but are absent from the open water field across the river (fig. 3, field#2) . Export of organic matter seems to be predominantly as fine detrital particles. Macrophyte primary production rates are high (Pickett, McKellar and Kelley, 1986) and the previous years standing crop has either become reduced to litter or tidally exported by the end of

February. Water fowl (especially wood ducks and mallards) are found in ditches at all tides and over the interditch areas on high tides. In the early 1980s hunters were frequently seen using the waterways provided by the ditches and the cover provided by the intertidal emergent plants to jump shoot ducks. Fishing is limited to breaches in dikes and deeper ditches. Continued recreational use of fields at this stage depends on whether or not waterways remain open.

Later stage fields; e.g., Quinby and Medway, are floristically more diverse than lower stage fields. Species appear that are generally considered to be terrestrial, for example, Rubus, Rhus and various trees. Animals found here are also more terrestrial than lower stage fields: copperhead snakes, rats, rabbits and deer. Ditches are filled in or closed by Ludwigia and Polygonum. Water fowl are scarce and human use is much less than in lower stage fields. Dominant plant species are more persistent after the winter die back and can be found standing well into the next growing season. Obvious detrital export appears to be reduced with most of the fields' decomposing organic matter seeming to stay in the field. As tree biomass increases, more of the productivity of the system becomes tied up in nonphotosynthetic support tissue. Runoff filtration is very likely greater in these later stage fields as the daily tidal water exchange budget is reduced.

The contribution of fields in different stages to the greater drainage basin is different and changes as succession proceeds. The profile of overall contribution of a particular stage to the greater system may be supportive to the health of the system at one point in time but less supportive to obvious needs later as succession replaces some functions. Some examples of functions that are stage dependent include:

1. specific habitat for endangered species
2. breeding habitat for game and non-game fish species
3. waterfowl refuges
4. export of primary production and timing of export
5. recreational opportunities for outdoorsmen
6. filtration of terrestrial runoff
7. amount and form of primary production
8. specific habitat for keystone invertebrate species
9. specific habitat for migratory species; e.g., striped bass, shad.

Remnant rice fields offer a unique opportunity for human intervention to preserve critical functions that are being lost to successional change. Dikes can be repaired and interiors managed to perpetuate these functions indefinitely.

Conclusions

1. Lowered water levels resulting from the redirection project have accelerated vegetational succession in the freshwater tidal regions (remnant rice fields) of the upper Cooper River.

2. A proposed sequence of stages is presented in Figure 38.

3. The role played by different stages in the ecology of the drainage basin is different.

Succession is therefore eliminating functions contributed by early stages and enhancing contributions made by later stages. Letting nature take its course is an active policy that may have detrimental consequences for the drainage basin.

4. The possibility of intervention to preserve functions identified to be critical is made feasible by the presence of repairable dikes. Human interventions in the ecology of the Cooper drainage basin are already numerous; e.g., dams blocking upstream access to breeding habitats, runoff from suburban, municipal and industrial development, disturbance by recreational users of waterways. Compensating interventions may be necessary to preserve system function and quality.

Recommendations for Further Research:

1. Identify specific functions of succession stages. Continue to track the accelerated process in the Cooper system.

2. Investigate the relationship between plant species/community presence and elevation so that rates of vegetational change can be modeled as a function elevation change (allows analysis of dynamics of sea level rise, sediment accumulation and water level management policy).

3. Develop a legal framework that will allow permitted repairs to strategically located fields with management conditions that accomplish ecological and recreational goals (perhaps, through a mitigation banking system).

Table 1

CHECKLIST OF VASCULAR PLANTS FROM THE COOPER RIVER, BACK RIVER, QUENBY CREEK AND HUGER CREEK, BERKELEY COUNTY, SOUTH CAROLINA

The following checklist of vascular plants represents plants collected from 1982 through 1995 by Richard D. Porcher from abandoned rice fields and river edges from the Back River, Western Branch and Eastern Branch of the Cooper River, Quenby Creek and Huger Creek. The specimens represent voucher specimens for field studies conducted by B. J. Kelley and R. D. Porcher. All specimens cited below are on deposit in The Citadel Herbarium. The number preceding each specimen is Porcher's field collection number.

- 2013 *Spartina cynosuroides* (L.) Roth; Berkeley County; 5 October, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2014 *Ludwigia repens* Forster; Berkeley County; 10 September, 1982; abandoned rice field, Medway Plantation, along west side of Back River; tidal freshwater marsh; CH.
- 2015 *Hypericum mutilum* L.; Berkeley County; 10 September, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2016 *Rhynchospora macrostachya* Torrey; 10 September, 1982; abandoned rice fields, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2017 *Lippia nodiflora* (L.) Michaux; Berkeley County; 10 September, 1982; rice fields, Medway Plantation, along west side of Back River; fresh water marsh; collected for CRWU grant; CH.
- 2018 *Echinorus cordatus* (L.) Grisebach; Berkeley County; 10 September, 1982; rice fields, Medway Plantation, along west side of Back River; fresh water marsh; collected for CRWU grant; CH.
- 2020 *Lobelia cardinalis* L.; Berkeley County; 8 October, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of Cooper River; tidal freshwater marsh; CH.
- 2021 *Lippia lanceolata* Michaux; Berkeley County; 1 November, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2022 *Thelypteris palustris* Schott; Berkeley County; 10 September, 1982; abandoned rice field, Medway Plantation, along west side of Back River; freshwater tidal marsh; CH.
- 2023 *Cyperus haspan* L.; Berkeley County; 1 October, 1982; abandoned rice fields, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2024 *Polygonum densiflorum* Meissner; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, along west side of Back River; freshwater tidal marsh; CH.
- 2025 *Juncus canadensis* J. Gay ex La Harpe; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, along west side of Back River; freshwater tidal marsh; CH.
- 2026 *Ludwigia palustris* (L.) Ell.; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, along west side of Back River; freshwater tidal marsh; CH.
- 2027 *Proserpinaca pectinata* Lam.; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, along west side of Back River; freshwater tidal marsh; CH.

- 2028 *Scirpus cyperinus* (L.) Kunth; Berkeley County; 22 October, 1982; Medway Plantation, Back River; freshwater marsh in abandoned rice fields; CH.
- 2029 *Hypericum virginicum* L.; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; tidal freshwater marsh; CH.
- 2030 *Anaethema keiskei* Hasskarl; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2031 *Eupatorium capillifolium* (Lam.) Small; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2032 *Salix caroliniana* Marshall; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2033 *Osmunda regalis* var. *spectabilis* (Willd.) Gray; Berkeley County; 22 October, 1982; abandoned rice fields, Medway Plantation, along west side of Back River; freshwater marsh; CH.
- 2034 *Juncus roemerianus* Scheele; Berkeley County; 22 October, 1982; abandoned rice fields, Medway Plantation, along west side of Back River; freshwater marsh; CH.
- 2035 *Onoclea sensibilis* L.; Berkeley County; 22 October, 1982; abandoned rice fields, Medway Plantation, along west side of Back River; freshwater marsh; CH.
- 2036 *Cephaanthus occidentalis* L.; Berkeley County; 22 October, 1982; abandoned rice fields, Medway Plantation, along west side of Back River; freshwater marsh; CH.
- 2037 *Habenaria repens* Nuttall; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2038 *Ludwigia leptocarpa* (Nuttall) Hara; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2039 *Acer rubrum* L.; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2040 *Liquidambar styraciflua* L.; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2041 *Ludwigia uruguayensis* (Camb.) Hara; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; tidal freshwater marsh; CH.
- 2042 *Diodia virginiana* L.; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; tidal freshwater marsh; CH.
- 2043 *Nyssa sylvatica* var. *biflora* (Walter) Sargent; Berkeley County; 22 October, 1982; abandoned rice field, Medway Plantation, west side of Back River; freshwater tidal marsh; CH.
- 2044 *Ludwigia alata* Ell.; Berkeley County; 10 September, 1982; abandoned rice field, Medway Plantation, west side of Back River; tidal freshwater marsh; CH.
- 2045 *Polygonum punctatum* Ell.; Berkeley County; 10 September, 1982; abandoned rice field, Medway Plantation, west side of Back River; tidal freshwater marsh; CH.

- 2046 *Lycopus rubellus* Moench; 10 September, 1982; abandoned rice field, Madway Plantation, west side of Back River; tidal freshwater marsh; CH.
- 2047 *Boehmeria cylindrica* (L.) Swartz; Berkeley County; 10 September, 1982; abandoned rice field, Madway Plantation, west side of Back River; tidal freshwater marsh; CH.
- 2048 *Cicuta maculata* L.; Berkeley County; 8 October, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2049 *Mikania scandens* (L.) Wild.; Berkeley County; 8 October, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2050 *Peltandra virginica* (L.) Kunth; Berkeley County; 8 October, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2051 *Alternanthera philoxeroides* (Marius) Grisebach; Berkeley County; 8 October, 1982; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2052 *Ipomoea sagittata* Cav.; Berkeley County; 8 October, 1982; abandoned rice fields, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2053 *Aster carolinianus* Walter; Berkeley County; 8 October, 1982; abandoned rice fields, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2054 *Cuscuta groenovii* Wild. ex R. & S.; Berkeley County; 8 October, 1982; abandoned rice fields, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2055 *Zizania aquatica* L.; Berkeley County; 8 October, 1982; abandoned rice fields, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2056 *Aster tenuifolius* L.; Berkeley County; 2 October, 1982; abandoned rice fields, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2057 *Cladium jamaicense* Crantz; Berkeley County; 29 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2058 *Kosteletskyia virginiana* (L.) Presl; Berkeley County; 29 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2059 *Eupatorium serotinum* Michaux; Berkeley County; 29 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2060 *Pilea fontana* (Lunell) Rydberg; Berkeley County; 29 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2061 *Impatiens capensis* Moench; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2062 *Polygonum sagittatum* L.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2063 *Spiranthes cernua* (L.) Richard; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.

- 2064 *Amaranthus cannabinus* (L.) J. D. Sauer; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2065 *Solidago sempervirens* L.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2066 *Polygonum arifolium* L.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2067 *Eupatorium perfoliatum* L.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2068 *Eupatorium coelestinum* L.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2069 *Apias americana* Modicus; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2070 *Lycopus rubellus* Moench; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2071 *Sacciolepis striata* (L.) Nash; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2072 *Lythrum lineare* L.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2073 *Habenaria repens* Nuttall; Berkeley County; 1 October, 1982; abandoned rice fields, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2074 *Verbena scabra* Vahl; Berkeley County; 1 October, 1982; abandoned rice fields, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2075 *Erianthus giganteus* (Walter) Muhl.; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation on Quenby Creek; freshwater marsh; CH.
- 2076 *Aster puniceus* L.; Berkeley County; 1 October, 1982; abandoned rice fields, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2077 *Scirpus americanus* Persoon; Berkeley County; 1 October, 1982; abandoned rice field, Quenby Plantation on Quenby Creek; freshwater marsh; CH.
- 2078 *Rhynchospora corniculata* (Lam.) Gray; Berkeley County; 1 October, 1982; Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2079 *Bidens laevis* (L.) BSP.; Berkeley County; 1 October, 1982; abandoned rice fields, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2080 *Pluchea camphorata* (L.) DC.; Berkeley County; 22 October, 1982; Medway Plantation; abandoned rice fields west side of Back River; freshwater tidal marsh; CH.
- 2212 *Impatiens capensis* Meerb.; Berkeley County; 27 September, 1988; Dean Hall rice fields, Western Branch of Cooper River; freshwater tidal marsh; CH.

- 2213 *Bidens laevis* (L.) BSP.; Berkeley County; 27 September, 1988; Dean Hall rice fields, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2214 *Polygonum arifolium* L.; Berkeley County; 27 September, 1988; Dean Hall rice fields, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2215 *Lycopus rubellus* Moench; Berkeley County; 27 September, 1988; Dean Hall rice fields, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2216 *Anaethema kniskerni* Hasskari; Berkeley County; 27 September, 1988; Dean Hall rice fields, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2217 *Mikania scandens* (L.) Willd.; Berkeley County; 24 August, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2218 *Zizania aquatica* L.; Berkeley County; 25 August, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2219 *Amaranthus cannabinus* (L.) J. D. Sauer; Berkeley County; 20 August, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2220 *Aplos americana* Medicus; Berkeley County; 20 August, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2221 *Lythrum lineare* L.; Berkeley County; 20 August, 1988; abandoned rice field, Dean Hall, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2222 *Polygonum sagittatum* L.; Berkeley County; 20 August, 1988; abandoned rice field, Dean Hall, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2223 *Cicuta maculata* L.; Berkeley County; 15 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2224 *Alternanthera philoxeroides* (Martius) Grisebach; Berkeley County; 15 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2225 *Pontederia cordata* L.; Berkeley County; 15 July, 1988; abandoned rice field, Dean Hall, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2226 *Hibiscus moscheutos* L.; Berkeley County; 15 July, 1988; abandoned rice fields, Dean Hall, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2227 *Ludwigia uruguayensis* (Camp.) Hara; Berkeley County; 15 July, 1988; abandoned rice field, Dean Hall, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2228 *Scirpus americanus* Persoon; Berkeley County; 1 June, 1988; abandoned rice field, Dean Hall, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2229 *Ptilimnium capillaceum* (Michaux) Raf.; Berkeley County; 19 June, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.

- 2230 *Eryngium aquaticum* L. var. *aquaticum*; Berkeley County; 5 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; tidal freshwater marsh; CH.
- 2231 *Sium suave* Walter; Berkeley County; 15 July, 1988; abandoned rice field, Dean Hall, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2232 *Spartina cynosuroides* (L.) Roth; Berkeley County; 17 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2233 *Cladium jamaicense* Gratz; Berkeley County; 17 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2234 *Juncus effusus* L.; Berkeley County; 17 July, 1988; abandoned rice field, Dean Hall, Western Branch of Cooper River; freshwater tidal marsh; first identified as *Scirpus validus* by Porcher; CH.
- 2235 *Galium obtusum* Bigelow; Berkeley County; 17 July, 1988; abandoned rice field, Dean Hall, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2236 *Lippia lanceolata* Michaux; Berkeley County; 17 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2237 *Peltandra virginica* (L.) Kunth; Berkeley County; 24 July, 1988; abandoned rice field, Dean Hall, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2238 *Cyperus pseudovegetus* Stuedel; Berkeley County; 17 July, 1988; abandoned rice field, Dean Hall, Western Branch of Cooper River; freshwater tidal marsh; CH.
- 2240 *Sacciolepis striata* (L.) Nash; Berkeley County; 27 September, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; CH.
- 2241 *Orontium aquaticum* L.; Berkeley County; 25 August, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2242 *Rumex verticillatus* L.; Berkeley County; 19 June, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2243 *Lobelia cardinalis* L.; Berkeley County; 15 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2244 *Ipomoea sagittata* Cav.; Berkeley County; 24 July, 1988; abandoned rice field, Dean Hall Plantation, Western Branch of the Cooper River; freshwater tidal marsh; CH.
- 2359 *Cabomba caroliniana* Gray; Berkeley County, South Carolina; 22 July, 1994; tidal freshwater marsh, Quenby Creek; CH.
- 2360 *Eryngium aquaticum* L. var. *aquaticum*; Berkeley County; 22 July, 1994; tidal freshwater marsh, Quenby Creek; CH.
- 2361 *Physostegia leptophylla* Small; Berkeley County, South Carolina; 22 July, 1994; tidal freshwater marsh, Quenby Creek; CH.

- 2367 *Sagittaria latifolia* Willd.; Berkeley County, South Carolina; 29 July, 1994; tidal freshwater marsh, Huger Creek; CH.
- 2368 *Lippia lanceolata* Michaux; Berkeley County, South Carolina; 29 July, 1994; tidal freshwater marsh, Huger Creek; CH.
- 2369 *Rhynchospora corniculata* (Lam.) Gray; Berkeley County, South Carolina; 29 July, 1994; tidal freshwater marsh, Huger Creek; CH.
- 2370 *Scirpus americanus* Persoon; Berkeley County, South Carolina; 29 July, 1994; tidal freshwater marsh, Huger Creek; CH.
- 2385 *Eupatorium serotinum* Michaux; Berkeley County, South Carolina; 15 September, 1994; tidal freshwater marsh along Cooper River; CH.
- 2386 *Hypericum walteri* Griseb.; Berkeley County, South Carolina; 15 September, 1994; tidal freshwater marsh along Cooper River; CH.
- 2387 *Aeschynomene indica* L.; Berkeley County, South Carolina; 15 September, 1994; edge of Quenby Creek at Hammer Boat Landing; CH.
- 2388 *Boltonia caroliniana* (Walter) Fernald; Berkeley County, South Carolina; 22 September, 1994; tidal freshwater marsh along French Quarter Creek; CH.
- 2389 *Habenaria repens* Nuttall; Berkeley County, South Carolina; 22 September, 1994; tidal freshwater marsh along French Quarter Creek; CH.
- 2390 *Sagittaria lancifolia* L.; Berkeley County, South Carolina; 22 September, 1994; tidal freshwater marsh along French Quarter Creek; CH.
- 2479a *Sagittaria subulata* Buch. var. *subulata*; Berkeley County; 1 August, 1995; former rice field of Dean Hall Plantation, Western Branch of the Cooper River; rooted in creek bottom that runs through the field; CH.
- 2480a *Potamogeton* sp.; Berkeley County; 1 August, 1995; former rice field of Dean Hall Plantation, Western Branch of the Cooper River; submerged in creek running through rice field; CH.
- 2517 *Verbena scabra* Vahl; Berkeley County; 9 August, 1995; former rice field of Medway Plantation, Back River; freshwater tidal marsh; CH.
- 2518 *Commelina virginica* L.; Berkeley County; 9 August, 1995; former rice field of Medway Plantation, Back River; freshwater tidal marsh; CH.
- 2519 *Echinocorus cordifolius* (L.) Griseb.; Berkeley County; 9 August, 1995; former rice field of Medway Plantation, Back River; freshwater tidal marsh; CH.
- 2520 *Najas gracillima* Magnus; Berkeley County; 9 August, 1995; Back River adjacent to Medway Plantation; submerged, freshwater; CH.
- 2539 *Cynoctonum mitreola* (L.) Britton; Berkeley County; 17 August, 1995; abandoned rice field of Quenby Plantation along Quenby Creek adjacent to SC-98; freshwater tidal marsh; CH.

- 2540 *Ludwigia alata* Ell.; Berkeley County; 17 August, 1995; abandoned rice field of Quenby Plantation along Quenby Creek adjacent to SC-98; freshwater tidal marsh; CH.
- 2541 *Vernonia noveboracensis* (L.) Michaux; Berkeley County; 17 August, 1995; abandoned rice field of Quenby Plantation along Quenby Creek adjacent to SC-98; freshwater tidal marsh; CH.
- 2542 *Ceratophyllum demersum* L.; Berkeley County; 17 August, 1995; Quenby Creek near SC-98; submersed; CH.
- 2566 *Cuscuta gronovii* Willd. ex R. & S.; Berkeley County; 17 August, 1995; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.
- 2567 *Rhynchospora caduca* Ell.; Berkeley County; 17 August, 1995; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2568 *Eleocharis microcarpa* Torrey; Berkeley County; 17 August, 1995; abandoned rice field, Quenby Plantation, Quenby Creek; tidal freshwater marsh; CH.
- 2587 *Cyperus haspan* L.; Berkeley County; 17 August, 1995; abandoned rice field, Quenby Plantation, Quenby Creek; freshwater tidal marsh; CH.

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